

ATOP-R&D

Human Factors Newsletter # 06-05

February 25, 2006 - March 10, 2006

Articles in this newsletter:

- Pilot-Based Spacing and Separation on Approach to Landing: The Effect on Air Traffic Controller Workload and Performance
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Technical Note: McAnulty, M., & Zingale, C. (2005). *Pilot-Based Spacing and Separation on Approach to Landing: The Effect on Air Traffic Controller Workload and Performance*. (DOT/FAA/CT-05/14). Atlantic City International Airport, NJ: Federal Aviation Administration, William J. Hughes Technical Center.

<u>Abstract</u>

This document summarizes the existing literature on issues related to pilot-based spacing and separation and the workload and performance of pilots and Air Traffic Control Specialists (ATCSs). Pilot self-spacing is one of the methods under investigation by the FAA and other air traffic organizations around the world for managing expected increases in traffic volume. Pilot self-spacing shifts the responsibility for spacing between aircraft from the controller (who is monitoring multiple aircraft) to the pilot, who can focus on the lead aircraft and use highly accurate information on a Cockpit Display of Traffic Information (CDTI) display to achieve precise spacing. The CDTI displays information about nearby air traffic (e.g., location, altitude, direction of flight) to the pilot relative to ownship. More advanced CDTIs may also include

functions that alert the pilot to potential conflicts or provide guidance about optimum flight paths or speed. Multiple variations of pilot self-spacing are under development for application in the en route, terminal, and airport surface environment.

The focus of this document is on those concepts planned for earliest implementation and proposed for use during sequencing and merging and on final approach. These concepts include: CDTI Assisted Visual Separation (CAVS), Enhanced Visual Approach (EVApp), Visual Separation on Approach (VSA), Approach Spacing for Instrument Approaches (ASIA), Independent Closely Spaced Parallel Approaches (ICSPA), National Aeronautics and Space Administration (NASA) Distributed Air-Ground Traffic Management (DAG TM) Concept Element 11 (CE11), and Sequencing and Merging (S&M).

Of these, CAVS, EVApp, and VSA are considered more ready for near-term implementation in that they involve little or no change to current procedures, and would require only basic CDTI functionality on the flight deck side. The literature indicates that pilot use of a basic CDTI to assist in visually acquiring traffic and following a lead aircraft is beneficial, and that pilot workload is generally acceptable. Controller reaction to pilot use of the CDTI for these purposes has also been generally positive.

The more advanced concepts (ASIA, ICSPA, NASA DAG TM CE11, and S&M) would require modifications to current procedures and more sophisticated CDTI capabilities for the pilot, and additional controller workstation tools. The results from most flight deck and air traffic control studies indicate that the advanced concepts are not mature and require further development before they become operationally feasible. To view the publication, point to: http://hf.tc.faa.gov:

This research activity supports the Administrator's Flight Plan Goal for Increased Safety, Objective 5: Enhance the safety of FAA's air traffic systems. It also supports the Administrator's Flight Plan Goal for Greater Capacity, Objective 3: Increase on-time performance of scheduled carriers.

Point of Contact: M. McAnulty, WJHTC

Technical Note: Ahlstrom, U., & Friedman-Berg, F. (2005). *Subjective Workload Ratings and Eye Movement Activity Measures* (DOT/FAA/CT-05/32). Atlantic City International Airport, NJ: Federal Aviation Administration William J. Hughes Technical Center.

Abstract

In the present study, we evaluated the possibility of using eye movement activity measures as a correlate of cognitive workload. Using data from a high-fidelity human-in-the-loop weather simulation, we explored eye activity measures like pupil diameter, blink duration, and saccade distance, and assessed their relationship to subjective workload ratings. In our initial analysis, we established that although there was no significant effect of weather tool use on subjective workload ratings, there was a significant relationship between subjective workload ratings and our task load variable aircraft density. We found a linear increase in workload ratings with an increasing number of aircraft in the sector. In a subsequent analysis, we assessed the relationship between eye movement activity measures and aircraft density. We found that the mean blink

duration and the mean saccade distance decreased as aircraft density increased, while the mean pupil diameter increased with an increasing number of aircraft in the sector.

After establishing the relationship between these eye activity metrics and subjective workload, we evaluated whether we could use changes in eye movement activity along with other system state variables, like distance to weather from the outer marker, to measure ongoing controller workload. We developed both individual controller models and a general model (across controllers) to assess whether it was possible to predict the minute-by-minute number of aircraft in the sector. Using both multiple regression modeling and neural network models, we were able to produce individual controller models and general models with good prediction performances. We discuss possible applications for these findings in future air traffic control (ATC) research, in adaptive automation, and in ATC interface design. To view the publication, point to: http://hf.tc.faa.gov:

This research activity supports the Administrator's Flight Plan Goal for Increased Safety, Objective 5: Enhance the safety of FAA's air traffic systems. It also supports the Administrator's Flight Plan Goal for Greater Capacity, Objective 3: Increase on-time performance of scheduled carriers.

Point of Contact: U. Ahlstrom, WJHTC

Human Factors Research Review: The FY2005 ATO-P R&D Human Factors Research and Engineering Division Technical Program Review provides a short description of FAA-funded human factors research projects and products. For a copy of the report, please point to http://www.hf.faa.gov. This activity supports the Administrator's Flight Plan Goal for Organizational Excellence, Objective 3: Make decisions based on reliable data to improve our overall performance and customer satisfaction. (P. Krois, ATO-P R&D)

International Visit: On February 27- March 3, 2005, CAMI personnel participated in a series of human factors briefings provided to three resident physicians (two from Iraq and one from Turkey). Information was provided regarding current research activities and related human factors issues and concerns. *This activity supports the Administrator's Flight Plan Goal for International Leadership, Objective 1: Promote improved safety and regulatory oversight in cooperation with bilateral, regional, and multilateral aviation partners.* (D. Schroeder, CAMI)

FAA Academy: In February, 2005, Carol Manning and Jerry Crutchfield met with Frank Durso (Texas Tech University) and Rick Dillbeck (Evansville, Indiana Tower) to design and pilot test a study to measure information requirements in the FAA Academy's tower simulator. After scenarios are developed and the methodology is finalized, a full study will be conducted in July of this year. This activity supports the Administrator's Flight Plan Goal for Organizational Excellence, Objectives 1 and 3: Make the organization more effective with stronger leadership, increased commitment of individual workers to fulfill organization-wide goals, and a better prepared, better trained, safer, diverse workforce.

(C. Manning, CAMI)

New Grant Submission Process: Please be aware that all new proposals for the FAA Aviation Research Grants Program must be submitted electronically by researchers at http://www.grants.gov. This information is also posted on the FAA Grants Office website at http://www.tc.faa.gov/logistics/gov. Currently, the FAA Grants Office is accepting amended proposals for follow-on work through the mail. However, they will eventually be migrating toward submission of amendments through grants.gov. Requests for no-cost extensions are being accepted by e-mail. If and when that changes, we will notify you. *This activity supports the Administrator's Flight Plan Goal for Organizational Excellence, Objective 3: Make decisions based on reliable data to improve our overall performance and customer satisfaction.* (T. McCloy, ATO-P R&D)

Technical Note: M.L. Cummings, Chris G. Tsonis, Massachusetts Institute of Technology, Cambridge, MA. *Partitioning Complexity in Air Traffic Management Tasks.* (Note: to appear in the International Journal of Aviation Psychology. This article is a product of a CAMI research grant titled "Developing Measures of Information Complexity in ATC Displays").

Summary

Cognitive complexity is a term that appears frequently in air traffic control (ATC) research literature, yet there is little principled investigation of the potential sources of cognitive complexity. Three distinctly different sources of cognitive complexity are proposed which are environmental, organizational, and display complexity. Displays should reduce complexity and hence workload through transforming high-workload cognitive tasks such as mental computations into lower workload tasks through direct perception. However, in complex and dynamic socio-technical domains such as ATC, it is not always clear whether displays and organizational interventions actually alleviate or contribute to the problem of complexity.

Two experiments were conducted to explore whether or not these proposed components of complexity could be effectively partitioned, measured, and compared. The findings demonstrate that sources of complexity can be decomposed and measured. Specifically, two sources of complexity, environmental and display, were partitioned in a basic en route ATC control task and a simplified ground traffic management task. In both experiments, the environmental complexity factors were predominant. However, in the case of a timeline task, the use of color in the displays added to, instead of reducing environmental complexity. The results suggest that display and organizational interventions could add to overall complexity and not reduce it.

This research activity supports the Administrator's Flight Plan Goal for Increased Safety, Objective 5: Enhance the safety of FAA's air traffic systems.

Point of Contact: Jing Xing, CAMI

ATC Displays: CAMI representative Jing Xing traveled to MIT in Cambridge, MA to review progress on a research grant titled "Developing Measures of Information Complexity in ATC Displays." Researchers in MIT's Human and Automation Laboratory recently developed a reprogrammable ATC simulation interface and performed a study investigating the embedding of information in ATC data blocks. Several research papers have been produced under this grant.

Moreover, grant results have provided benefit to several other MIT research initiatives: (1) A Defense Advanced Research Projects Agency/DoD project to develop displays for controlling future highly autonomous Unmanned Aerial Vehicles (UAVs); (2) a project titled "Integrate Sensing and Decision Support" with Lincoln Laboratories; and, (3) a US Air Force project on Single Operator Consolidation for the Shadow UAV. In summary, this CAMI grant has been a success not only for the FAA, but also for other government services. This research activity supports the Administrator's Flight Plan Goal for Increased Safety, Objective 5: Enhance the safety of FAA's air traffic systems. (Jing Xing, CAMI)

En Route ATC: Four first-line en route supervisors participated in an Early User Involvement Event at the William J. Hughes Technical Center's Research, Development, and Human Factors Laboratory. The supervisors evaluated several configurations of an automatic data block offset algorithm. The data entries needed to move data blocks on the en route radar display account for approximately 20% of all controller entries. An algorithm that alleviates the need for these data entries potentially makes time and resources available for other controller tasks. This research activity supports the Administrator's Flight Plan Goal for Increased Safety, Objective 5: Enhance the safety of FAA's air traffic systems. It also supports the Administrator's Flight Plan Goal for Greater Capacity, Objective 3: Increase on-time performance of scheduled carriers. (B. Willems, WJHTC)

Lunchtime Talk: On Thursday, March 9, 2006, Dr. Qiping Zhang, Assistant Professor, College of Information Science and Technology at Drexel University, gave a talk at the William J. Hughes Technical Center on "Trust in Global Virtual Communities".

Abstract: Trust is key to collaboration in the virtual community. In the past decades, vast literature studies have been developed on how information technologies influence personal trust in virtual communities. However, one major limitation of our theory-building efforts is that the large majority of data has been collected from members of western cultures. In this talk, two current research projects that are intended to help overcome the western bias in research will be reported. First, a culture communication study implies that providing a media rich channel like video to virtual teams with no previous interpersonal relationships may engender a high level of trust and thus improve performance. Second, in a "blog" study, Americans indicated a higher level of trust by disclosing more information in their profile than Korean and Chinese "bloggers".

This activity supports the Administrator's Flight Plan Goal for Organizational Excellence, Objectives 1 and 3: Make the organization more effective with stronger leadership, increased commitment of individual workers to fulfill organization-wide goals, and a better prepared, better trained, safer, diverse workforce; Make decisions based on reliable data to improve our overall performance and customer satisfaction.

Point of Contact: K. Allendoerfer, WJHTC

More information on human factors research can be found at the FAA Human Factors (ATOP-R&D) web site: http://www.hf.faa.gov

Paul Krois FAA (ATO-P R&D Human Factors)



March 13-15, 2006 – Flight Safety Foundation 18th Annual European Aviation Safety Seminar, Athens, Greece http://www.flightsafety.org/seminars.html#eass

March 20-23, 2006 – 16th Annual AAMI/FDA International Conference on Medical Device Standards and Regulation, Hyatt Regency, Reston, VA http://www.aami.org/meetings/isc/index.html

March 22 - 25, 2006 - Society for Behavioral Medicine Annual Meeting and Scientific Sessions, San Francisco, CA www.sbm.org/annualmeeting/index.html

March 22-23, 2006 - 16th Annual AAMI- FDA International Conference on Medical Device Standards and Regulation, Hyatt Regency, Reston, VA http://www.aami.org/meetings/isc/index.html

March 23-25, 2006 - 17th Annual International Women in Aviation Conference, Opryland Hotel Nashville, TN http://www.wai.org/

March 23-27, 2005 – IA Summit 2006, Hyatt Regency, Vancouver, BC, Canada http://www.iasummit.org/

March 25-29, 2006 – IEEE Virtual Reality Conference, Hilton Alexandria Mark Center, Alexandria, VA http://www.vr2006.org/

March 27-31, 2006 – International Federation of Air Traffic Controllers Annual Conference, Kaohsiung, Taiwan http://www.ifatca.org/conferences/annual_conference.htm

March 28-30, 2006 – PAMA 35th Annual Aviation Maintenance Symposium, Las Vegas Convention Center, Las Vegas, NV http://www.sae.org/events/pama/ams/

March 28-30, 2006 – Aviation Industry Expo, Las Vegas, NV http://www.aviationindustryexpo.com

April 4-5, 2006 – 7th Airline Maintenance Conference, Crowne Plaza Hotel, Prague, Poland http://www.aviationindustrygroup.com/index.cfm?pg=137#section_introduction

April 4-10, 2006 – Sun 'n Fun, Lakeland, FL http://www.sun-n-fun.org/content/

April 6-7, 2006 – National Human Capital Summit, Chicago Marriott Downtown, Chicago, IL http://www.humancapitalinstitute.net/conference_national.html

April 17-19, 2006 – NBAA Maintenance Management Conference, Dallas, TX http://web.nbaa.org/public/cs/mmc/200604/

April 18-20, 2006 – FAA Aviation Safety Programs Conference, Grand Hyatt Hotel, Denver, CO http://www.aviationsafetyconference.com

April 22-27, 2006 – CHI 2006, Montreal, Quebec, Canada http://www.chi2006.org/call/hcioverviews.php

April 23-28, 2006 - Avionics Systems Division Meeting, New Orleans, LA (TBD) lemon@sae.org

April 24-25, 2006 – AIAA Inside Aerospace...An International Perspective, Renaissance, Washington, Wash, DC http://www.aiaa.org/content.cfm?pageid=230&lumeetingid=1388

April 24-26, 2005 – ATCA/FAA/NASA Annual Technical Symposium, Atlantic City, NJ http://www.atca.org/activities/event_items.asp?month=4&year=2006&item_id=3557

April 25-27, 2006 – Maintenance, Repair & Overhaul (MRO) Conference & Exhibition, Phoenix Civic Plaza, Phoenix, AZ http://www.aviationnow.com/conferences/mromain.htm

May 1-4, 2006 - 47th AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference; 14th AIAA/ASME/AHS Adaptive Structures Conference; 7th AIAA Gossamer Spacecraft Forum; 2nd AIAA Multidisciplinary Design Optimization Specialist Conference; 1st AIAA Non-Deterministic Approaches Conference, Hyatt Regency Newport, Newport, RI http://www.aiaa.org/

May 3-5, 2006 - 6th Annual European Business Aviation Convention & Exhibition (EBACE2006), *Geneva, Switzerland http://web.nbaa.org/public/cs/amc/*May 9-11, 2006 - Flight Safety Foundation 51st Annual Corporate Aviation Safety Seminar, Phoenix, AZ http://www.flightsafety.org/seminars.html#eass

May 14-18, 2006 - 77th Annual Scientific Meeting of the Aerospace Medical Association, Caribe Royale Hotel, Orlando, FL http://www.asma.org/

May 15-16, 2006 – DoD TAG, Las Vegas, NV http://hfetag.dtic.mil/meetschl.html

May 15-16, 2006 – ASTM F38 Unmanned Aircraft Systems Committee Workshop, Sheraton Centre Toronto; Toronto, ON CAN http://www.astm.org/

May 17-19, 2006 – 17th International Conference on Heating and Ventilation, Prague, Czech Republic http://www.acv2006.cz

May 22-24, 2006 - 9th IFAC Symposium on Automated Systems Based on Human Skill And Knowledge, Nancy, France http://www.cdc.gov/niosh/exhibits.html

May 23-25, 2006 – Defense Standardization Program Conference, Westin Arlington Gateway, Arlington, VA http://www.sae.org/events/dsp/

May 23-25, 2006 – 2006 International Air Cargo Conference, Brown Convention Center, Houston, TX mailto:terryiacc@bellsouth.net

May 25-28, 2006 – American Psychological Society 18th Annual Convention, New York Marriott Marquis, New York City, NY http://www.psychologicalscience.org/convention/

June 6-8, 2006 – IEE System Safety Conference, Savoy Place, London, UK http://www.iee.org/events/event/CE202BA5-A0D3-8FE7-2F35A59A02C8B3F3

June 8-10, 2006 – NTSB Bar Association Annual CLE Conference, NTSB Conference Center, L'Enfant Plaza, Wash, DC http://www.ntsbbar.org/

June 11-14, 2006 – The American Society of Safety Engineers Safety 2006 Conference, Washington State Convention and Trade Center, Seattle, WA http://www.asse.org/2006pdcallforpapers.pdf

June 12-16, 2006 – UPA 2006 – 15th Annual Conference, Broomfield, CO http://www.usabilityprofessionals.org/conferences and events/upa conference/2006/

June 24-26, 2006 – AAMI Conference & Exposition, Wash, DC http://www.aami.org/proposals/index.html

June 24-28, 2006 – ASHRAE Annual Conference, Quebec, Canada http://www.ashrae.org/

June 26-29, 2006 - General Aviation Technology Conference, Hyatt Hotel, Wichita, Kansas,

July, 2006 - 26th International Congress of Applied Psychology, Athens, Greece dgeorgas@dp.uoa.gr,

http://www.erasmus.gr/dynamic/conventions.asp?conv_id=21r/dynamic/conventions.asp?conv_i d=21

July 10-14, 2006 – IEA 2006, 16th World Congress on Ergonomics, Maastricht, The Netherlands http://www.iea2006.org/

July 24-30, 2006 – EAA AirVenture, Oshkosh, WI http://www.airventure.org/

July 26-29, 2006 – CogSci 2006, Sheraton Vancouver Wall Centre, Vancouver, BC, Canada

http://www.cogsci.rpi.edu/~rsun/cogsci2006/

August 1, 2006 - The International Journal of Aviation Psychology, Special Issue on Air Traffic Control Human Factors, CALL FOR PAPERS. Please contact Jim Hitt at hitt_james@bah.com < mailto:hitt_james@bah.com> or Mike McAnulty at mike.mcanulty@faa.gov < mailto:mike.mcanulty@faa.gov> with any queries, or to submit papers.

August 10-13, 2006 – American Psychological Association Annual Meeting, New Orleans, LA http://www.apa.org/convention05/future.html

August 21-24, 2006 - AIAA Modeling and Simulation Technologies Conference and Exhibit. Keystone Resort and Conference Center, Keystone, CO http://www.aiaa.org/content.cfm?pageid=1

August 21-24, 2006 - AIAA Guidance, Navigation, and Control Conference and Exhibit, Keystone Resort and Conference Center, Keystone, CO http://www.aiaa.org/content.cfm?pageid=1

August 29-31, 2006 – General Aviation Technology Conference & Exhibition, Wichita Hyatt, Wichita, KS http://www.sae.org/events/gat/

September 6-8, 2006 - 11th AIAA/ISSMO Multidisciplinary Analysis and Optimization Conference, Renaissance Portsmouth, Portsmouth, VA, http://www.aiaa.org/content.cfm?pageid=1

September 10-14, 2006 - 54th International Congress of Aviation and Space Medicine, Bangalore, India. A preliminary registration form may be found at http://www.isam-india.org/conference44/newreg.php.

September 12-14, 2006 -23^{rd} International Air Cargo Forum and Exposition, Calgary, Ontario, Canada http://www.tiaca.org

September 20-22, 2006 – HCI-Aero 2006, Seattle, WA http://www.eurisco.org/hci-aero2006 Note: Submission Deadlines:

15th March 2006 - Full Research Papers

15 April 2006 - Industry Papers

15 April 2006 - Early Stage Research Papers

15 April 2006 - Panels, Workshops

15 April 2006 - Posters and Demos

September 26-27, 2006 – AIAA Aviation Technology, Integration and Operations Conference, Hyatt Regency, Wichita, KS http://www.aiaa.org/content.cfm?pageid=1

October 8-11, 2006 - IEEE International Conference on Systems, Man, and Cybernetics, The Grand Hotel, Taipei, Taiwan http://ins.cn.nctu.edu.tw/smc2006/

March 1, 2006: Deadline for submission of papers (full papers only)

October 15-19, 2006 – Digital Avionics Systems Conference, 25th DASC Network Centric Environment: The Impact on Avionics and Systems, Hilton Portland and Executive Tower, Portland, OR www.dasconline.org

February 19, 2006 – Deadline for submitting abstracts of 1000 words

October 15-20, 2006 – 2nd Annual Augmented Cognition International Conference, Hilton San Francisco, San Francisco, CA <u>www.augmentedcognition.org</u>

October 16-20, 2006 – Human Factors and Ergonomics Society Annual Meeting, San Francisco Hilton, San Francisco, CA http://www.hfes.org/web/HFESMeetings/meetings.html Key Dates:

March 1, 2006 - Proposals (all presentation types)

April 18, 2006 - Accept/reject letters sent

May 8, 2006 - Workshop preliminary handouts due

May 16, 2006 - Proceedings paper prep instructions available

May 22, 2006 - Workshop final acceptances sent

June 5, 2006 - Online preliminary program available

June 26, 2006 - Proceedings papers due

September 8, 2006 - Early registration deadline

October 17-19, 2006 – NBAA 59th Annual Meeting and Convention, Orlando, FL http://web.nbaa.org/public/cs/amc/futuresites.php

October 23-25, 2006 – 44th Annual SAFE Symposium, Reno Hilton Hotel, Reno, NV http://www.safeassociation.org/symposium.htm

October 23-26, 2006 - DoD Maintenance Symposium & Exhibition, Reno Hilton, Reno, Nevada http://www.sae.org/events/conferences/aerospace/

October 29 - November 1, 2006 – ATCA Convention and Exposition, Marriott Wardman Park, Wash, DC

November 9-11, 2006 – AOPA Expo 2006, Palm Springs, CA http://www.aopa.org/expo/2005/virtual/

November 13-14, 2006 ASTM F38 Unmanned Aircraft Systems Committee Workshop, Hyatt Regency, Atlanta, GA http://www.astm.org/

January 8-11, 2007 - 45th AIAA Aerospace Sciences Meeting and Exhibit, Reno Hilton, Reno, NV http://www.aiaa.org/content.cfm?pageid=1

January 27-31, 2007 - ASHRAE Winter Meeting, Dallas, TX <u>jyoung@ashrae.org</u>, or <u>www.ashrae.org</u>.

May 21-22, 2007 - ASTM F38 Unmanned Aircraft Systems Committee Workshop, Waterside Convention Center, Norfolk, VA http://www.astm.org/

June 23-27, 2007 – ASHRAE Annual Meeting, Long Beach, CA <u>jyoung@ashrae.org</u>, <u>www.ashrae.org</u>

July 22-27, 2007 – 12th HCI International, Beijing, China http://www.hcii2007.org/

September 25-27, 2007 - NBAA 60th Annual Meeting and Convention, Atlanta, GA http://web.nbaa.org/public/cs/amc/futuresites.php

October 1-5, 2007 – Human Factors and Ergonomics Society Annual Meeting, Baltimore Waterfront Marriott Hotel, Baltimore, MD http://www.hfes.org/web/HFESMeetings/meetings.html

November 13-16, 2007 – DoD Maintenance Symposium and Exhibition, Rosen Shingle Creek, Orlando, FL http://www.sae.org/events/conferences/aerospace/

Note: Calendar events in Italics are new since the last Newsletter



Comments or questions regarding this newsletter? Please contact Bill Berger at (334) 271-2928 or via e-mail at bill.ctr.berger @faa.gov